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# NAVAL RESEARCH LABORATORY

## E.O. Hulburt Center for Space Research

Monthly Progress Report  
for the  
SOLAR-B Mission  
Extreme Ultraviolet (EUV) Imaging Spectrometer (EIS)  
Instrument Components

Phase C/D Cumulative Project Period Through 31 August 2002


EIS\_Prog\_Report37

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Submitted to:

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## Table of Contents

Section	Title	Page
1.0	Introduction	1
2.0	Phase C/D Schedule	1
3.0	Summary of Work Accomplished During Reporting Period	1
3.1	Science Objectives	1
3.2	Design Principles	1
3.2.1	Hardware Design	1
3.2.2	Systems Engineering	2
3.3	Documentation	2
3.3.1	Contract Documents	2
3.4	Meetings	3
4.0	Summary of Work to be Accomplished During Upcoming Reporting Period	3
4.1	Science Objectives	3
4.2	Design Principles	3
4.3	Documentation	3
4.4	Meetings	3
5.0	Technical Problems and Impact to Science Objectives	3
6.0	Science Instrument Interfaces	4
7.0	Current Areas of Concern	4
8.0	Cost Summary	4
9.0	Program Metrics	4
10.0	Risk Assessment	5

Appendix A EIS Instrument Components Preliminary Master Schedule

## List of Figures

Number	Figure	Page
1	CDR RID Clearance Summary	5
2	EIS Instrument Components Program Schedule Contingency	5



## **List of Tables**

<b>Number</b>	<b>Title</b>	<b>Page</b>
1	EIS Instrument Components Mass Figures	4
2	Top Ten Risks Associated with the NRL Instrument Components	7



## 1.0 INTRODUCTION

This Monthly Progress Report covers the reporting period through August 2002, Phase C/D, Detailed Design and Development Through Launch Plus Thirty Days, for selected components and subsystems of the Extreme ultraviolet Imaging Spectrometer (EIS) instrument, hereafter referred to as EIS Instrument Components. This document contains the program status through the reporting period and forecasts the status for the upcoming reporting period. This document has been developed in accordance with Data Requirements Description 887MA-002.

## 2.0 PHASE C/D SCHEDULE

Appendix A presents the EIS Instrument Components program schedule, reflecting progress through August 26, 2002. The program schedule reflects activities through Phases C/D and launch. The program schedule reflects the one-year launch delay. The detailed program schedule is provided in Appendix A.

## 3.0 SUMMARY OF WORK ACCOMPLISHED DURING REPORTING PERIOD

During the month of August, the following work was accomplished on the EIS Instrument Components.

### 3.1 Science Objectives

During the reporting period, the NRL science team worked on generating simulated EIS data which will be useful for better understanding the kinds of observations EIS will be able to make, assessing data processing and file structure issues and developing the IDL software for data processing and analysis. Completion of this data will occur during the next reporting period.

The NRL science team is now making preparations to support the EIS Science Meeting which will be held at the MSSL facility in the UK, 18 – 19 November 2002.

### 3.2 Design Principles

#### 3.2.1 Hardware Design

Various aspects of the EIS hardware design were worked during the reporting period. A summary of these activities includes:

- During the reporting period, NRL has been monitoring two parallel optical coating processes at GSFC and Columbia University. Each organization has been performing test coatings on witness optics and providing the results to NRL for evaluation on performance. Results from Columbia achieved good uniformity, within the EIS spec of  $\pm 1\%$ , over the masked half of 6" and 4" silicon wafers except near the mask edge and near the outer perimeter of the wafers. Columbia



attributed these edge effects to shadowing by the mask edge and the NRL holder that slightly protrude above the wafer surface. Columbia plans to modify the mask and holder to mitigate these edge effects, which NRL has approved;

- NRL delivered the pathfinder Grating optic (F2) to GSFC for coating. The F2 grating was ruled 90° off axis and will serve as a test sample for the GSFC coatings and subsequent testing of the LORT GSE at the Brookhaven facility to be used during optics characterization;
- A site visit was made to the Columbia facility by Therese Errigo to review contamination controls in-place at the coating facility and to make recommendations prior to receiving flight optics. Discrepancies noted during the visit were corrected prior to the close of the reporting period. Flight optics will be provided to Columbia at the start of the next reporting period;
- Installed and tested the Large Optics Reflectance Turntable (LORT) at the Brookhaven facility. The system was successfully integrated and tested inside the chamber;
- The shipping container for the flight GRA was completed and precision cleaned;
- The flight model piece-parts are continued going through final drawing sign-off, fabrication and QA inspection;
- Review of the mechanical grounding of the NRL provided assemblies was conducted. Rework of various mechanical parts is currently underway;
- Life test continued on the DM Shutter assembly, having completed over 50 million cycles with no anomalies observed. The life test will require a total of 80 million cycles. The life testing is being performed at the Perdix facility in New Hampshire;
- The brassboard MDE boards were successfully integrated to the Protomodel Instrument Control Unit (ICU) at the Mullard Space Science Laboratory (MSSL). The testing included a complete end-to-end testing of the ICU-MHC-Mechanisms test.

### 3.2.2 Systems Engineering

Continued participation in weekly teleconference calls with MSSL and the University of Birmingham, via a three-way calling scheme, to discuss EIS systems engineering issues. Emphasis has now been placed on statusing the flight instrument program in the UK. The flight structure panels are now under fabrication at McLaren.

## 3.3 Documentation

### 3.3.1 Contract Documents

During the reporting period the following documents were submitted:

- EIS Instruments Components Monthly Progress Report submitted in accordance with 887MA-002



- EIS Instrument Components Financial Management Report (533M) submitted in accordance with DRD 887MA-003;

### 3.4 Meetings

- ICU-to-MHC integration at the MSSL facility in the UK, 1 – 9 August 2002.

## 4.0 SUMMARY OF WORK TO BE ACCOMPLISHED DURING UPCOMING REPORTING PERIOD

During the next month, September 2002, the following work is scheduled to be conducted on the EIS Instrument Components.

### 4.1 Science Objectives

Continue to work the issues identified in the July Solar-B Operations Meeting held at SAO and prepare for the November EIS Science Meeting.

### 4.2 Design Principles

The following work is proposed for the next reporting period:

- Multilayer coat a minimum one set of Mirror and Grating flight optics;
- Characterize a minimum one set of Mirror and Grating flight optics;
- Conduct the Pre-Environmental Review at NRL;
- Conduct Material Review Board meeting on SLA components.

### 4.3 Documentation

During the next reporting period, the following documentation is to be submitted:

- EIS Instrument Components Monthly Progress Report per 887MA-002;
- EIS Instrument Components Financial Management Report (533M) per 887MA-003.

### 4.4 Meetings

The following meetings are planned for August:

- Pre-Environmental Review (PER) at the NRL facility on 17 September 2002.

## 5.0 TECHNICAL PROBLEMS AND IMPACT TO SCIENCE OBJECTIVES

At this time there are no significant problems identified that would impact the EIS science objectives.



## 6.0 SCIENCE INSTRUMENT INTERFACES

Table 1 presents the updated mass estimates for the EIS Instrument Components.

Table 1. EIS Instrument Components Estimated Mass Figures

ITEM	ACRONYM	MASS (kg)	TOTAL (kg)	COMMENTS
<b>NRL Instrument Components</b>				
Primary Mirror	MIR	3.37		Per NRL ICD
Grating	GRA	1.52		Per NRL ICD
Filters	FFA & SEF	0.19		Per NRL ICD
Slit/Slot/Shutter Assembly	SLA	0.73		Per NRL ICD
	<b>TOTAL</b>		<b>5.81</b>	

## 7.0 CURRENT AREAS OF CONCERN

The following areas are of concern at this time to the EIS development program:

- The necessity to implement adequate contamination control in Japan upon delivery of the EIS flight hardware to prevent contaminating the EIS optics.
- The NRL engineering team has completed a preliminary contamination model for the FFA and front aperture of the EIS instrument. These results show that there are serious concerns with contamination impacts from the spacecraft. NRL is working with MSSL to inform the J-side of the concerns and recommendations.

## 8.0 COST SUMMARY

Cost data has been removed from the Monthly Report and included as part of the EIS Instrument Components Financial Management Report (533M).

## 9.0 PROGRAM METRICS

Following the successful completion of the EIS CDR, NRL is required to report on two program metrics; progress on clearing CDR RIDs and schedule contingency. Figure 1 presents the current status of the RID clearance where it is showing, on a monthly basis, the number of RIDs that require data to be submitted by NRL (Goal), the number of RIDs for which NRL submitted data (Submitted) and the number of RIDs that have been cleared by MSFC (Cleared).

Figure 2 is a graphic presentation of the total EIS Instrument Components program funded schedule contingency.



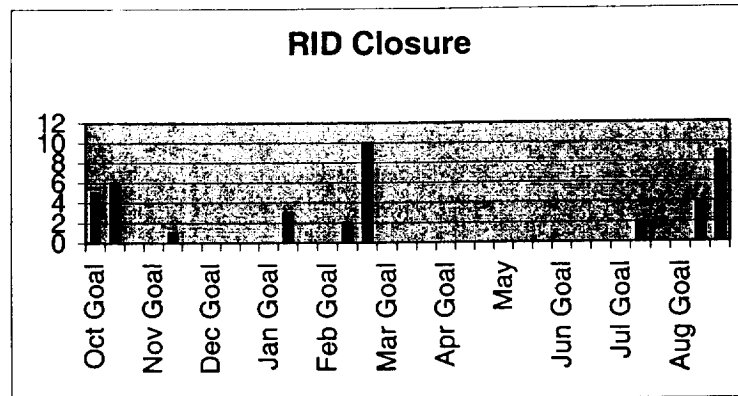


Figure 1. CDR RID Clearance Summary

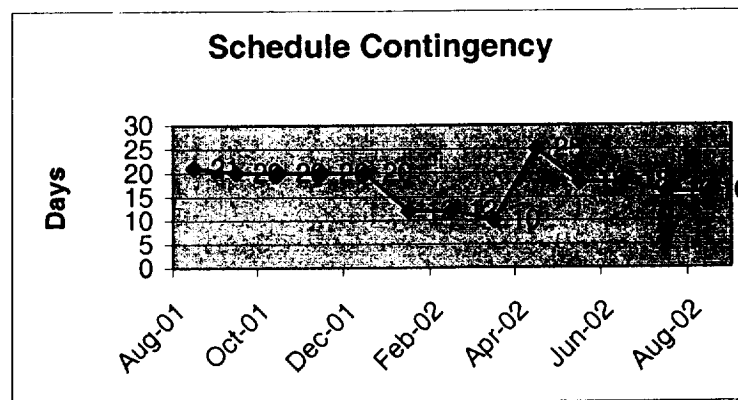


Figure 2. EIS Instrument Components Program Schedule Contingency

## 10.0 RISK ASSESSMENT

Table 2 contains a listing of the top risks associated with the NRL EIS Instrument Components program. The purpose of this list is to identify and track the top risks. Each risk is assigned a probability figure, which can be described qualitatively as:

<i><b>Term</b></i>	<i><b>Notation</b></i>
Impossible	0
Very unlikely	1
Unlikely	2
Moderately Unlikely	4
Moderately Probable	6
Probable	8
Very Probable	9
Certain	10
Unknown	99



Table 2. Top Six Risks Associated with the NRL EIS Instrument Components

Priority	Probability	Event	Effect	Management	Notes
1	1	Failure of the flight Grating optic manufacturer (Zeiss) to meet the delivery schedule.	Late delivery will impact delivery of the flight GRA assembly to the UK for EIS Instrument integration.	NRL has implemented schedule contingency into the flight GRA development program.	Zeiss has delivered two of the required three flight optics. The third flight optic is currently under fabrication. Delay in this delivery will have minimal impact on the flight program
2	1	Failure of the flight Grating optic manufacturer (Zeiss) to meet the procurement specifications; manufacturing defects.	Depending on degree of defects, optics may be found to produce loss of throughput, may be unusable for flight.	NRL has placed three Grating optics on order in accordance with the Grating Procurement Specification. In addition, NRL has placed on order, with Zeiss, three optical blanks as back-up optics to minimize the procurement time.	Zeiss has proven capabilities to meet the procurement specifications for making the Grating optics. NRL has received preliminary test data, which shows the optics, are conforming to the procurement specification.
3	3	Inability to maintain uniformity and reproducibility when applying the optical multi-layer coatings.	Loss of optical throughput	<ol style="list-style-type: none"> <li>1. There is currently a test program underway where a series of wafer samples are undergoing the multi layer coating process and then evaluated for performance;</li> <li>2. Three optics for both the MIR and GRA are being procured to allow for errors..</li> </ol>	NRL currently has two parallel coating evaluations underway at GSFC and Columbia University. Data has not yet been received from the Columbia facility, however, the data from GSFC is providing increased confidence that GSFC can meet the coating requirements.
4	2	Subassembly failure during environmental testing	Delay in delivery while rework and retest are underway.	The program schedule currently contains four weeks of schedule contingency for the test program.	



Table 2. Top Six Risks Associated with the NRL EIS Instrument Components (Continued)

Priority	Probability	Event	Effect	Management	Notes
5	1	Failure of an NRL delivered component to integrate properly into the EIS Instrument	Delay in delivery of the EIS Instrument to the J-side during rework and retest.	<p>NRL has provided mass models of the GRA, SLA and MIR confirming the subassembly footprints for inclusion into the EIS MTM/TTM model;</p> <p>NRL has integrated the FFA into the University of Birmingham provided EM Clamshell assembly;</p> <p>NRL has successfully integrated the breadboard MDE Analog and Digital PWA's to the MSSL provided MHC EM power subsystem.</p>	
6	6	Contamination of the EIS Instrument during integration, test and early orbit.	Loss of total instrument throughput.	NRL is working with the UK contamination team to ensure that adequate controls and design modification are incorporated.	Under the current EIS Instrument design, the preliminary contamination model performed on the FFA and front aperture of the instrument shows a high probability of contamination from the spacecraft. Evaluation of the witness mirrors in the MTM structure at the completion of the MTM testing showed acceptable levels, verifying adequate handling techniques in place for the EIS instrument.



WBS Code	Description	Rem Dur	Early Start	Early Finish	2000	2001	2002	2003	2004	2005
0.1	Solar-B Master Schedule Major Milestones	781 *	08/15/01 A	09/01/05						
1.1	Protomodel Test in Japan	0	08/15/01 A	09/12/01 A						
1.2	MTM/TTM Test in Japan	54	05/22/02 A	11/07/02						
1.3	EIS Instrument Flight Hardware Due at ISAS	0	12/02/03							
1.4	S/C Integration and Test	427	12/02/03	07/20/05						
1.5	Launch	0	09/01/05							
0.2	Solar-B EIS Instrument Components	824 *	02/01/99 A	10/31/05						
A	Phase A: Concept Study	0	02/01/99 A	10/29/99 A						
B	Phase B: Definition and Preliminary Design	0	11/01/99 A	12/31/00 A						
C	Phase C: Detailed Design	0	01/01/01 A	07/11/01 A						
D	Phase D: Development Through Launch Plus 30 Days	803	07/12/01 A	09/30/05						
E	Phase E: Mission Operations and Data Analysis	21	10/03/05	10/31/05						
1.0	Management, Science & Co-Investigators	824 *	02/01/99 A	10/31/05						
1.1	Project Management	742 *	09/01/99 A	08/01/05						
1.1.1	Meetings - Programmatic	742 *	09/01/99 A	08/01/05						
1.1.1.1	Requirements Review	0	09/01/99 A	09/02/99 A						
1.1.1.2	Concept Review	0	10/28/99 A	10/29/99 A						
1.1.1.3	Preliminary Design Review	0	05/11/00 A	05/11/00 A						
1.1.1.4	EIS Instrument UK Preliminary Design Review	0	07/06/00 A	07/07/00 A						
1.1.1.5	Confirmation Review	0	11/30/00 A							
1.1.1.6	Critical Design Review	0	07/11/01 A							
1.1.1.7	Pre-Environmental Review	0	09/17/02							
1.1.1.8	Pre-Ship/Acceptance Review	0	01/08/03							
1.1.1.9	Mission Readiness Review	0	08/01/05							
1.1.2	Meetings - Scientific	2 *	11/15/99 A	11/19/02						
1.1.2.1	EIS Science Meeting - NRL	0	11/15/99 A	11/19/99 A						
1.1.2.2	SOLAR-B Science Meeting - ISAS	0	12/09/99 A	12/10/99 A						
1.1.2.3	EIS Science Meeting - MSSL	0	02/09/00 A	02/09/00 A						
1.1.2.4	EIS Science Meeting - MSSL	0	05/24/00 A	05/26/00 A						
1.1.2.5	EIS Science Meeting - RAL	0	11/15/00 A	11/17/00 A						
1.1.2.6	Solar-B Science meeting - ISAS	0	12/04/00 A	12/06/00 A						
1.1.2.7	EIS Science Meeting - MSSL	0	04/23/01 A	04/24/01 A						
1.1.2.8	EIS Science Meeting - NRL	0	01/16/02 A	01/18/02 A						
1.1.2.9	Solar-B Science Meeting - Hawaii	0	01/25/02 A	01/26/02 A						
1.1.2.10	MO&DA Workshop - SAO	0	07/17/02 A	07/19/02 A						
1.1.2.11	EIS Science Meeting - MSSL	2	11/18/02	11/19/02						
1.1.3	Meetings - Technical	2 *	12/11/99 A	11/21/02						
1.1.3.1	EIS Engineering Meeting - ISAS	0	12/11/99 A	12/15/99 A						
1.1.3.2	EIS Engineering Meeting - ISAS	0	03/06/00 A	03/08/00 A						
1.1.3.3	EIS Engineering Meeting - ISAS	0	06/20/00 A	06/22/00 A						
1.1.3.4	EIS Engineering Meeting - Univ. Birmingham	0	10/04/00 A	10/06/00 A						
1.1.3.5	EIS Engineering Meeting - ISAS	0	12/07/00 A	12/09/00 A						
1.1.3.6	Engineering Working Group- Univ. Birmingham	0	02/21/01 A	02/23/01 A						







WBS Code	Description	Rem Dur	Early Start	Early Finish	2000	2001	2002	2003	2004	2005
2.1.1	Development Model (DM) Filter Assembly	0 *	06/01/99 A	04/09/02 A						
2.1.1.1	Specify filter requirements	0	06/01/99 A	08/02/99 A						
2.1.1.2	Design Filter Frame	0	08/03/99 A	07/03/00 A						
2.1.1.4	Procure DM Filter Frames	0	09/15/00 A	01/12/01 A						
2.1.1.5	Fit Check DM Filter Frames	0	01/15/01 A	01/26/01 A						
2.1.1.6	Procure Commercial Equivalent Filter	0	11/27/00 A	03/23/01 A						
2.1.1.7	Integrate DM Filter Assembly	0	03/26/01 A	06/01/01 A						
2.1.1.8	Fabricate Mock-up Clamshell Assembly (UB)	0	01/08/01 A	05/11/01 A						
2.1.1.9	Vacuum Test EM Clamshell	0	06/04/01 A	06/15/01 A						
2.1.1.10	Integrate FFA Assembly for Test	0	07/23/01 A	07/25/01 A						
2.1.1.11	Fabricate vibration test fixture	0	04/23/01 A	04/27/01 A						
2.1.1.12	Visual Inspection	0	06/26/01 A	06/26/01 A						
2.1.1.13	DM Acoustic Test	0	06/27/01 A	06/28/01 A						
2.1.1.14	Visual Inspection/Light Leak Test	0	06/28/01 A	06/29/01 A						
2.1.1.15	DM qualification level vibration test	0	07/25/01 A	07/27/01 A						
2.1.1.16	Visual Inspection	0	07/27/01 A	07/27/01 A						
2.1.1.17	Test Anomaly Evaluation	0	07/30/01 A	08/17/01 A						
2.1.1.18	Update DM filter design	0	08/20/01 A	09/21/01 A						
2.1.1.19	Procure updated DM filters	0	09/24/01 A	01/30/02 A						
2.1.1.20	Visual Inspection	0	02/04/02 A	02/06/02 A						
2.1.1.21	DM qualification vibration test	0	04/04/02 A	04/05/02 A						
2.1.1.22	Visual Inspection/Light Leak Test	0	04/08/02 A	04/09/02 A						
2.1.2	Flight Model (FM) Filter	87 *	08/27/01 A	01/02/03						
2.1.2.1	Update Filter Design	0	08/27/01 A	08/21/02 A						
2.1.2.2	Detailed thermal analysis of CLM (Swales)	0	10/22/01 A	02/22/02 A						
2.1.2.3	Procure Flight Filter(s)	27	08/22/02 A	10/01/02						
2.1.2.4	Evaluate Flight Filter Assembly	5	10/02/02	10/08/02						
2.1.2.5	Integrate to Clamshell Housing	5	10/09/02	10/15/02						
2.1.2.6	Test and Debug	10	10/16/02	10/29/02						
2.1.2.7	FFA Contingency	40	10/30/02	01/02/03						
2.2	Mirror Assembly	87 *	02/01/99 A	01/02/03						
2.2.1	Development Model (DM) Mirror Assembly	0 *	06/01/99 A	03/15/02 A						
2.2.1.1	Define Mirror optical requirements	0	06/01/99 A	11/01/99 A						
2.2.1.2	Preliminary design fine scan mechanism	0	06/01/99 A	11/01/99 A						
2.2.1.3	Fabricate fine scan mechanism	0	11/02/99 A	12/13/99 A						
2.2.1.4	Test/debug fine scan mechanism	0	12/13/99 A	01/07/00 A						
2.2.1.5	Preliminary design coarse scan mechanism	0	12/15/99 A	02/15/00 A						
2.2.1.6	Fabricate coarse scan subassembly	0	02/16/00 A	03/07/00 A						
2.2.1.7	Procure commercial mechanism stepper motor/resol	0	04/10/00 A	08/11/00 A						
2.2.1.8	Assembly scanning mechanism	0	08/14/00 A	01/05/01 A						
2.2.1.9	Conduct static load testing	0	01/08/01 A	01/19/01 A						
2.2.1.10	Develop bonding technique procedures	0	12/06/99 A	12/17/99 A						



WBS Code	Description	Rem Dur	Early Start	Early Finish	2000	2001	2002	2003	2004	2005
2.2.1.11	Perform bonding test case using mass sim glass	0	12/17/99 A	12/23/99 A						
2.2.1.12	Perform pull/strength test on bond case	0	12/24/99 A	12/30/99 A						
2.2.1.13	Evaluate lightweighting MIR optics	0	12/18/00 A	04/13/01 A						
2.2.1.14	Black Anodize Machine Parts	0	04/02/01 A	04/13/01 A						
2.2.1.15	Integrate mirror assembly	0	04/16/01 A	04/20/01 A						
2.2.1.16	Test and Debug/Functional Tests	0	06/11/01 A	06/15/01 A						
2.2.1.17	Fabricate vibration test fixture	0	04/23/01 A	04/27/01 A						
2.2.1.18	Vibration Test	0	06/18/01 A	06/20/01 A						
2.2.1.19	Functional Test	0	07/09/01 A	07/10/01 A						
2.2.1.20	Thermal Vacuum Test	0	07/12/01 A	08/22/01 A						
2.2.1.21	Functional Test	0	08/23/01 A	08/24/01 A						
2.2.1.22	Life Test	0	02/05/02 A	03/15/02 A						
2.2.1.23	Functional Test	0	02/18/02 A	02/20/02 A						
2.2.2	Flight Model (FM) Mirror	61 *	04/02/01 A	11/18/02						
2.2.2.1	Update optical design	0	02/11/02 A	02/22/02 A						
2.2.2.2	Update scanning mechanism design	0	02/11/02 A	02/22/02 A						
2.2.2.3	Procure Primary Mirror	0 *	07/23/01 A	04/24/02 A						
2.2.2.3.1	Mechanical model acid etch	0	07/23/01 A	10/12/01 A						
2.2.2.3.2	Mechanical model best fit sphere	0	10/15/01 A	10/26/01 A						
2.2.2.3.3	Primary mirrors acid etch	0	10/29/01 A	11/13/01 A						
2.2.2.3.4	Primary mirrors (3) best fit sphere	0	11/14/01 A	12/28/01 A						
2.2.2.3.5	Finish Primary Mirror (#1)	0	11/30/01 A	12/20/01 A						
2.2.2.3.6	Evaluate front surface scratch to Mirror (#1)	0	01/28/02 A	03/20/02 A						
2.2.2.3.7	Finish Primary Mirror (#2)	0	11/30/01 A	03/29/02 A						
2.2.2.3.8	Finish Primary Mirror (#3)	0	11/30/01 A	03/29/02 A						
2.2.2.3.9	Deliver Primary Mirrors #1 - 3	0	03/29/02 A	04/24/02 A						
2.2.2.4	Coat primary mirror	10	09/16/02	09/27/02						
2.2.2.5	Characterize primary mirror	10	09/30/02	10/11/02						
2.2.2.6	Procure flight stepper motor/resolver	0	04/02/01 A	10/19/01 A						
2.2.2.7	Fabricate and assemble scanning mechanism	10	01/07/02 A	09/06/02						
2.2.2.8	Integrate scanning mechanism - mirror	5	10/14/02	10/18/02						
2.2.2.9	Telescope optical functional testing	15	10/21/02	11/08/02						
2.2.2.10	Mirror Contingency	6	11/11/02 A	11/18/02						
2.3	Slit and Shutter Assembly	61 *	06/01/99 A	11/18/02						
2.3.1	Slit Assembly Development Model (DM)	0 *	06/01/99 A	02/28/02 A						
2.3.1.1	Define slit/slot configuration	0	06/01/99 A	03/20/00 A						
2.3.1.2	Design motor & gearhead assembly	0	07/13/99 A	02/07/00 A						
2.3.1.3	Procure motor & gearhead assembly	0	04/10/00 A	08/11/00 A						
2.3.1.4	Fabricate slit/slot inserts	0	01/12/01 A	05/25/01 A						
2.3.1.5	Assemble DM Slit/Slot Assembly	0	12/04/00 A	07/27/01 A						
2.3.1.6	Test, debug, functional test	0	07/30/01 A	09/07/01 A						
2.3.1.7	Fabricate test fixture	0	04/23/01 A	04/27/01 A						



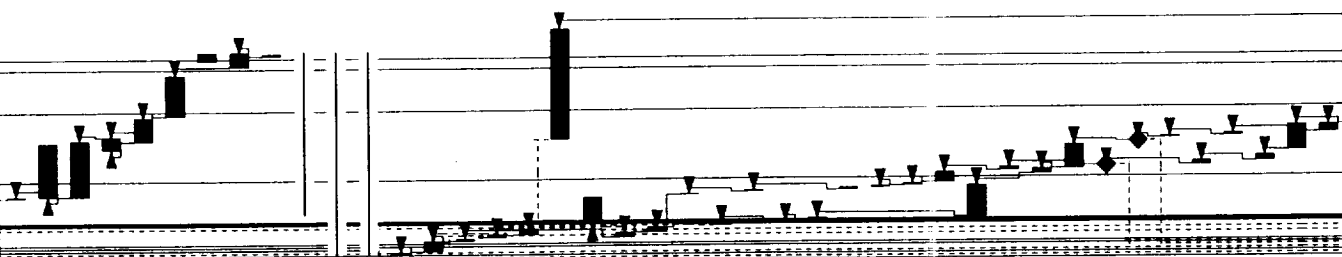
WBS Code	Description	Rem Dur	Early Start	Early Finish	2000	2001	2002	2003	2004	2005
2.3.1.8	Vibration Test	0	11/19/01 A	11/20/01 A						
2.3.1.9	Functional Test	0	11/20/01 A	11/23/01 A						
2.3.1.10	Thermal Vacuum Test	0	11/28/01 A	12/14/01 A						
2.3.1.11	Functional Test	0	12/17/01 A	12/18/01 A						
2.3.1.12	Life test	0	02/18/02 A	02/27/02 A						
2.3.1.13	Functional Test	0	02/28/02 A	02/28/02 A						
2.3.2	Shutter Assembly Development Model (DM)	30 *	06/01/99 A	10/04/02						
2.3.2.1	Define shutter assembly requirements	0	06/01/99 A	02/07/00 A						
2.3.2.2	Procure shutter components	0	02/07/00 A	04/28/00 A						
2.3.2.3	Fabricate shutter wheel	0	11/01/00 A	11/22/00 A						
2.3.2.4	Assembly shutter assembly	0	05/01/00 A	11/27/00 A						
2.3.2.5	Test, debug and functional test	0	11/28/00 A	01/19/01 A						
2.3.2.6	Vibration Test	0	11/19/01 A	11/20/01 A						
2.3.2.7	Functional Test	0	11/20/01 A	11/23/01 A						
2.3.2.8	Thermal Vacuum Test	0	11/28/01 A	12/14/01 A						
2.3.2.9	Functional Test	0	12/17/01 A	12/18/01 A						
2.3.2.10	Life Test	28	02/18/02 A	10/02/02						
2.3.2.11	Functional Test	2	10/03/02	10/04/02						
2.3.3	Flight Model Slit/Shutter Assemblies	61 *	04/02/01 A	11/18/02						
2.3.3.1	Update Slit assembly design	0	02/18/02 A	05/01/02 A						
2.3.3.2	Update Shutter design	0	02/18/02 A	05/01/02 A						
2.3.3.3	Procure slit motor & gearhead assemblies	0	04/02/01 A	01/25/02 A						
2.3.3.4	Procure Shutter components	0	12/17/01 A	03/11/02 A						
2.3.3.5	Fabricate slit/slot and shutter wheels	12	07/22/02 A	09/10/02						
2.3.3.6	Assemble slit/slot assembly	17	08/26/02 A	09/17/02						
2.3.3.7	Assemble shutter assembly	17	08/26/02 A	09/17/02						
2.3.3.8	Integrate Shutter/Slit Assemblies	10	09/18/02	10/01/02						
2.3.3.9	Test and Debug	20	10/02/02	10/29/02						
2.3.3.10	SLA Contingency	14	10/30/02	11/18/02						
2.4	Spectrometer Filter Assembly	87 *	06/01/99 A	01/02/03						
2.4.1	Development Model (DM) Filter	0 *	06/01/99 A	04/17/02 A						
2.4.1.1	Specify Filter Requirements	0	06/01/99 A	08/02/99 A						
2.4.1.2	Develop Procurement Specification	0	08/03/99 A	09/13/99 A						
2.4.1.3	Procure DM Filter	0	04/23/01 A	07/20/01 A						
2.4.1.4	Evaluate Filter Design	0	07/23/01 A	08/03/01 A						
2.4.1.5	Visual Inspection	0	08/06/01 A	08/07/01 A						
2.4.1.6	Vibration Test	0	08/09/01 A	08/09/01 A						
2.4.1.7	Visual Inspection	0	08/10/01 A	08/10/01 A						
2.4.1.8	Test anomaly evaluation	0	08/13/01 A	08/24/01 A						
2.4.1.9	Update DM filter design	0	08/27/01 A	09/07/01 A						
2.4.1.10	Procure updated filters	0	09/10/01 A	09/26/01 A						
2.4.1.11	Visual inspection	0	09/27/01 A	09/28/01 A						
2.4.1.12	DM qualification level acoustic test	0	10/09/01 A	10/10/01 A						



WBS Code	Description	Rem Dur	Early Start	Early Finish	2000	2001	2002	2003	2004	2005
2.4.1.13	Visual inspection/light leak test	0	10/11/01 A	10/11/01 A						
2.4.1.14	DM qualification level vibration test	0	10/16/01 A	10/18/01 A						
2.4.1.15	Visual inspection/light leak test	0	10/19/01 A	10/19/01 A						
2.4.1.16	Test Anomaly Evaluation	0	10/22/01 A	11/02/01 A						
2.4.1.17	Procure Updated filter design	0	11/05/01 A	04/05/02 A						
2.4.1.18	Visual Inpsect/Light Leak Test	0	04/08/02 A	04/10/02 A						
2.4.1.19	DM Qualification Vibration Test	0	04/11/02 A	04/12/02 A						
2.4.1.20	Visual Inspection/Light Leak Test	0	04/15/02 A	04/17/02 A						
2.4.2	Flight Model Filter	87 *	10/22/01 A	01/02/03						
2.4.2.1	Update Filter Design	0	10/22/01 A	07/12/02 A						
2.4.2.2	Procure Flight Filter(s)	27	08/22/02 A	10/01/02						
2.4.2.3	Evaluate Filter Design	20	10/02/02	10/29/02						
2.4.2.4	SEF Contingency	40	10/30/02	01/02/03						
2.5	Grating Assembly	61 *	02/01/99 A	11/18/02						
2.5.1	Development Model (DM) Grating Assembly	0 *	02/01/99 A	05/29/02 A						
2.5.1.1	Define Grating optical requirements	0	02/01/99 A	11/05/99 A						
2.5.1.2	Design focussing mechanism	0	04/26/99 A	12/31/99 A						
2.5.1.3	Fabricate focussing mechanism	0	12/31/99 A	03/23/00 A						
2.5.1.4	Procure/fabricate Mass Sim Optic	0	12/04/00 A	12/15/00 A						
2.5.1.5	Procure Commercial Stepper Motors/Resolvers	0	04/10/00 A	09/13/00 A						
2.5.1.6	Assembly focussing mechanism	0	06/16/00 A	10/06/00 A						
2.5.1.7	Integrate mass sim	0	01/03/01 A	01/19/01 A						
2.5.1.8	Test and debug	0	01/22/01 A	02/09/01 A						
2.5.1.9	Static load testing	0	02/12/01 A	02/16/01 A						
2.5.1.10	Functional testing	0	02/26/01 A	10/19/01 A						
2.5.1.11	Fabricate test fixture	0	04/23/01 A	04/27/01 A						
2.5.1.12	Vibration	0	04/30/02 A	04/30/02 A						
2.5.1.13	Functional Test	0	05/01/02 A	05/02/02 A						
2.5.1.14	Thermal Vacuum	0	01/09/02 A	01/22/02 A						
2.5.1.15	Functional Test	0	01/23/02 A	01/25/02 A						
2.5.1.16	Life Test	0	05/21/02 A	05/27/02 A						
2.5.1.17	Functional Test	0	05/28/02 A	05/29/02 A						
2.5.2	Flight Model Grating	61 *	04/02/01 A	11/18/02						
2.5.2.1	Evaluate optical design	0	05/31/02 A	06/06/02 A						
2.5.2.2	Evaluate focussing mechanism design	0	05/31/02 A	06/06/02 A						
2.5.2.3	Procure flight grating	8 *	09/03/01 A	09/04/02						
2.5.2.3.1	Figuring of 9 substrates	0	09/03/01 A	09/28/01 A						
2.5.2.3.2	Metrology on 9 substrates	0	10/01/01 A	10/05/01 A						
2.5.2.3.3	Final correction on 5 substrates	0	10/08/01 A	10/19/01 A						
2.5.2.3.4	Metrology on 5 substrates	0	10/22/01 A	11/02/01 A						
2.5.2.3.5	Shaping of outer contour (all 9 substrates)	0	11/05/01 A	11/28/01 A						
2.5.2.3.6	Metrology (9 substrates)	0	11/29/01 A	12/21/01 A						



WBS Code	Description	Rem Dur	Early Start	Early Finish	2000	2001	2002	2003	2004	2005
2.5.2.3.7	Recording - Alignment Gratings	0	12/24/01 A	01/11/02 A						
2.5.2.3.8	Recording - Flight Gratings	0	12/24/01 A	02/26/02 A						
2.5.2.3.9	Ion etching - Flight Gratings	0	03/13/02 A	03/26/02 A						
2.5.2.3.10	Metrology - Alignment Gratings	0	01/14/02 A	01/18/02 A						
2.5.2.3.11	Metrology - Flight Gratings	0	03/27/02 A	04/04/02 A						
2.5.2.3.12	Coating (2 alignment gratings)	0	01/21/02 A	01/23/02 A						
2.5.2.3.13	Deliver to NRL - Alignment Gratings (2)	0		01/30/02 A						
2.5.2.3.14	Deliver to NRL - Flight Grating (1)	0		04/05/02 A						
2.5.2.3.15	Evaluate alignment grating	0	02/11/02 A	04/12/02 A						
2.5.2.3.16	Return alignment grating for rework	0	04/15/02 A	04/26/02 A						
2.5.2.3.17	Evaluate flight grating #1	0	04/10/02 A	04/16/02 A						
2.5.2.3.18	Re-record alignment gratings	0	05/27/02 A	08/16/02 A						
2.5.2.3.19	Remove photo resist from 2 flight gratings	0	04/22/02 A	05/17/02 A						
2.5.2.3.20	Smooth 2 flight gratings	0	05/20/02 A	05/24/02 A						
2.5.2.3.21	Recording - 2 flight gratings	0	05/27/02 A	05/30/02 A						
2.5.2.3.22	Ion etch - 1 flight gratings	0	05/31/02 A	06/04/02 A						
2.5.2.3.23	Metrology - Alignment Gratings	0	08/19/02 A	08/23/02 A						
2.5.2.3.24	Coat Alignment Gratings	3	08/26/02 A	08/28/02						
2.5.2.3.25	Metrology - 1 Flight Grating	0	06/05/02 A	06/07/02 A						
2.5.2.3.26	Deliver to NRL - Alignment Gratings (2)	5	08/29/02	09/04/02						
2.5.2.3.27	Deliver to NRL - Flight Grating	0	06/14/02 A	06/14/02 A						
2.5.2.4	Coat flight grating	10	09/09/02	09/20/02						
2.5.2.5	Characterize flight grating	10	09/23/02	10/04/02						
2.5.2.6	Procure/fabricate focusing mechanism (2)	5	06/21/02 A	08/30/02						
2.5.2.7	Procure flight stepper motor/resolver	0	04/02/01 A	01/18/02 A						
2.5.2.8	Assemble focusing mechanism	10	09/12/02	09/25/02						
2.5.2.9	Integrate focusing mechanism - alignment grating	5	09/26/02	10/02/02						
2.5.2.10	Integrate focusing mechanism - flight grating	5	10/07/02	10/11/02						
2.5.2.11	Spectrometer optical functional testing	20	10/14/02	11/08/02						
2.5.2.12	Grating Contingency	6	11/11/02 A	11/18/02						
2.6	Mechanism Driver Electronics	60 *	05/31/01 A	11/15/02						
2.6.1	Hardware: Analog, Digital and Auxliary CCA's	55 *	05/31/01 A	11/15/02						
2.6.1.1	Brassboard Development	0 *	05/31/01 A	08/01/02 A						
2.6.1.1.1	Integration of BB CCA's to Power Converter Subsy	0	06/04/01 A	06/08/01 A						
2.6.1.1.2	Test and Debug	0	05/31/01 A	07/06/01 A						
2.6.1.1.3	Develop Draft EEE Parts List	0	05/31/01 A	06/20/01 A						
2.6.1.1.4	Layout/fabricate Brassboard PWB's	0	07/30/01 A	11/13/01 A						
2.6.1.1.5	Procure/receive brassboard components	0	11/19/01 A	01/18/02 A						
2.6.1.1.6	Assemble brassboard CCA's	0	01/07/02 A	02/08/02 A						
2.6.1.1.7	Test and debug CCA's	0	01/17/02 A	06/10/02 A						
2.6.1.1.8	Integrate embedded code, test and debug	0	01/23/02 A	06/10/02 A						
2.6.1.1.9	Integrate and test with DM Pwr Converter Subsyz	0	06/11/02 A	06/14/02 A						





WBS Code		Description		Rem Dur	Early Start	Early Finish	2000	2001	2002	2003	2004	2005
2.6.1.1.10		Test and debug with DM mechanisms		0	06/17/02 A	07/26/02 A						
2.6.1.1.11		Deliver to MSSL for ICU integration and test		0		08/01/02 A						
2.6.1.2		Flight Development		55 *	05/31/01 A	11/15/02						
2.6.1.2.1		Flight parts list development		0	05/31/01 A	11/23/01 A						
2.6.1.2.2		Procurement plan development		0	06/11/01 A	08/03/01 A						
2.6.1.2.3		Flight parts procurement		0	11/26/01 A	03/22/02 A						
2.6.1.2.4		Flight parts receipt		0	12/21/01 A	05/24/02 A						
2.6.1.2.5		EEE parts screening		0	02/25/02 A	05/31/02 A						
2.6.1.2.6		Uprev and Release flight PWB's		10	09/02/02	09/13/02						
2.6.1.2.7		Procure PWB's		10	09/23/02	10/04/02						
2.6.1.2.8		Receive and inspect PWB's		5	10/07/02	10/11/02						
2.6.1.2.9		Coupon testing		15	10/07/02	10/25/02						
2.6.1.2.10		Release flight CCA drawing		0	09/16/02							
2.6.1.2.11		Generate CCA assembly drawings		10	09/16/02	09/27/02						
2.6.1.2.12		Kit CCA's		5	09/16/02	09/20/02						
2.6.1.2.13		Kit inspections		5	09/23/02	09/27/02						
2.6.1.2.14		Assemble CCA's		10	09/30/02	10/11/02						
2.6.1.2.15		Test and select trim values		10	10/07/02	10/18/02						
2.6.1.2.16		Rework (A/R) and inspection		3	10/21/02	10/23/02						
2.6.1.2.17		Integrate flight embedded code		3	10/24/02	10/28/02						
2.6.1.2.18		Functional test		5	10/29/02	11/04/02						
2.6.1.2.19		Integrate housing and power subsystem		3	11/05/02	11/07/02						
2.6.1.2.20		Functional test		3	11/08/02	11/12/02						
2.6.1.2.20		MDE Contingency		3	11/13/02 A	11/15/02						
2.6.1.2.22		Deliver flight MDE to MSSL		0		11/15/02 *						
2.6.2		Embedded Control Code		50 *	06/11/01 A	11/01/02						
2.6.2.1		Develop and deliver MDC simulator to MSSL		0	12/05/01 A	12/06/01 A						
2.6.2.2		Validate commanding/telemetry with ICU (MSSL)		0	12/17/01 A	01/11/02 A						
2.6.2.3		Update embedded code		0	06/11/01 A	01/23/02 A						
2.6.2.4		Integrate into brassboard hardware		0	01/23/02 A							
2.6.2.5		Test, Debug and Validate		25	01/25/02 A	09/27/02						
2.6.2.6		Integrate with Flight CCA's		0	09/30/02							
2.6.2.7		Test, Debug and Validate		25	09/30/02	11/01/02						
3		Ground Support Equipment and Proto Models		55 *	09/01/99 A	11/08/02						
3.1		Electrical Proto Model		0 *	11/01/99 A	07/06/01 A						
3.1.1		Mechanism Driver Electronics Proto Design		0	11/01/99 A	12/31/99 A						
3.1.2		Procure Components		0	12/31/99 A	02/10/00 A						
3.1.3		Fabricate PCB's		0	04/10/00 A	05/05/00 A						
3.1.4		Assembly Proto Model		0	02/11/00 A	03/09/00 A						
3.1.5		Test and Debug		0	05/26/00 A	07/06/01 A						
3.1.6		Develop CDR Data Package for MHC		0	05/21/01 A	07/06/01 A						
3.2		Mechanical/Thermal Prot Model		0 *	12/08/00 A	02/21/01 A						
3.2.1		Fabricate Grating Mass model		0	12/08/00 A	02/16/01 A						



WBS Code		Description		Rem Dur	Early Start	Early Finish	2000	2001	2002	2003	2004	2005
3.2.2		Deliver to MSSL		0	02/21/01 A							
3.2.3		Fabricate Mirror mass model		0	12/08/00 A	02/16/01 A						
3.2.4		Deliver to MSSL		0	02/21/01 A							
3.2.5		Fabricate Slit/Slot/Shutter mass model		0	12/08/00 A	02/16/01 A						
3.2.6		Deliver to MSSL		0	02/21/01 A							
3.3		Large Optics Reflectance Turntable - EGSE		5 *	05/27/02 A	08/30/02						
3.3.1		Procure motors and drivers		0	05/27/02 A	07/19/02 A						
3.3.3		Fabricate turntable pieces		0	05/27/02 A	07/23/02 A						
3.3.2		Fabricate control system		0	06/24/02 A	08/02/02 A						
3.3.4		Integrate LORT system		0	07/24/02 A	08/16/02 A						
3.3.5		Test and Debug at Brookhaven		5	08/19/02 A	08/30/02						
3.4		Mechanical Ground Support Equipment		55 *	02/01/00 A	11/08/02						
3.4.1		Define MGSE Requirements		0	02/01/00 A	04/24/00 A						
3.4.2		Fabricate MGSE		15	03/19/01 A	09/13/02						
3.4.3		Test MGSE		40	09/16/02	11/08/02						
3.5		Mock-ups and Simulators		0 *	09/01/99 A	01/12/01 A						
3.5.1		Front Filter Assembly		0 *	09/01/99 A	01/12/01 A						
3.5.1.1		Support UB in design of FFA Clamshell		0	09/01/99 A	03/28/00 A						
3.5.1.2		Support UB in fabrication of Clamshell		0	03/28/00 A	01/12/01 A						
4		Systems Engineering and Integration		803 *	02/02/99 A	09/30/05						
4.1		Systems Engineering		803 *	02/02/99 A	09/30/05						
4.1.1		Systems Engineering Support		803	02/02/99 A	09/30/05						
4.1.2		MSSL systems engineering support		327	06/01/99 A	12/04/03						
4.1.3		U. of B. systems engineering support		327	06/02/99 A	12/04/03						
4.2		Instrument Components Testing and Verification		40 *	11/19/02	01/22/03						
4.2.1		Environmental Acceptance Testing		39 *	11/19/02	01/21/03						
4.2.1.1		Assembly functional tests		3	11/19/02	11/21/02						
4.2.1.2		Acceptance level vibration		3	11/22/02	11/26/02						
4.2.1.3		Assembly functional test		3	11/27/02	12/03/02						
4.2.1.4		Thermal vacuum		10	12/04/02	12/17/02						
4.2.1.5		Assembly functional test		3	12/18/02	12/20/02						
4.2.1.6		Final optical throughput verification		4	12/30/02	01/02/03						
4.2.1.7		Final inspection		3	01/03/03	01/07/03						
4.2.1.8		Testing contingency		10	01/08/03	01/21/03						
4.2.2		Assembly Shipment		1 *	01/22/03	01/22/03						
4.2.2.1		Preparation for shipment		1	01/22/03	01/22/03						
4.2.2.2		Shipment to UK		0		01/22/03 *						
4.3		EIS System Integration and Test Support		218 *	01/30/03	12/02/03						
4.3.1		EIS Instrument Components Receipt at RAL		0	01/30/03							
4.3.2		EIS system integration		85	01/30/03	05/28/03						
4.3.3		EIS instrument test		45	05/29/03	07/30/03						
4.3.4		EIS instrument calibration		75	07/31/03	11/12/03						



WBS Code	Description	Rem Dur	Early Start	Early Finish	2000	2001	2002	2003	2004	2005
4.3.5	EIS MLI fit check; FFA change-out	13	11/13/03	12/01/03						
4.3.6	EIS instrument delivery to S/C	0	12/02/03							
<b>5</b>	<b>Operations</b>	<b>824 *</b>	<b>01/01/01 A</b>	<b>10/31/05</b>						
5.1	Mission Operations Definition and Planning	803	01/01/01 A	09/30/05						
5.2	Mission Operations Support	40	08/08/05	09/30/05						
5.3	EIS Coordinated Science Assessment	824	07/02/01 A	10/31/05						
<b>6</b>	<b>Product Assurance</b>	<b>101 *</b>	<b>11/01/99 A</b>	<b>01/22/03</b>						
6.1	Safety	101	11/01/99 A	01/22/03						
6.2	Quality	101	11/01/99 A	01/22/03						
6.3	Reliability	101	11/01/99 A	01/22/03						

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- Early bar
- Progress bar
- Critical bar
- Summary bar
- ▲ Progress point
- ▼ Critical point
- ◆ Summary point
- ◆ Start milestone point
- ◆ Finish milestone point



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